



# Medical Micropower Network Service in the 413-457 MHz Band

May, 2011

# Objective

Secure secondary allocation of spectrum  
for transformative medical technology

413 – 419  
MHz

Emergency  
Land Mobile  
Radio

426 – 432  
MHz

Radar

438 – 444  
MHz

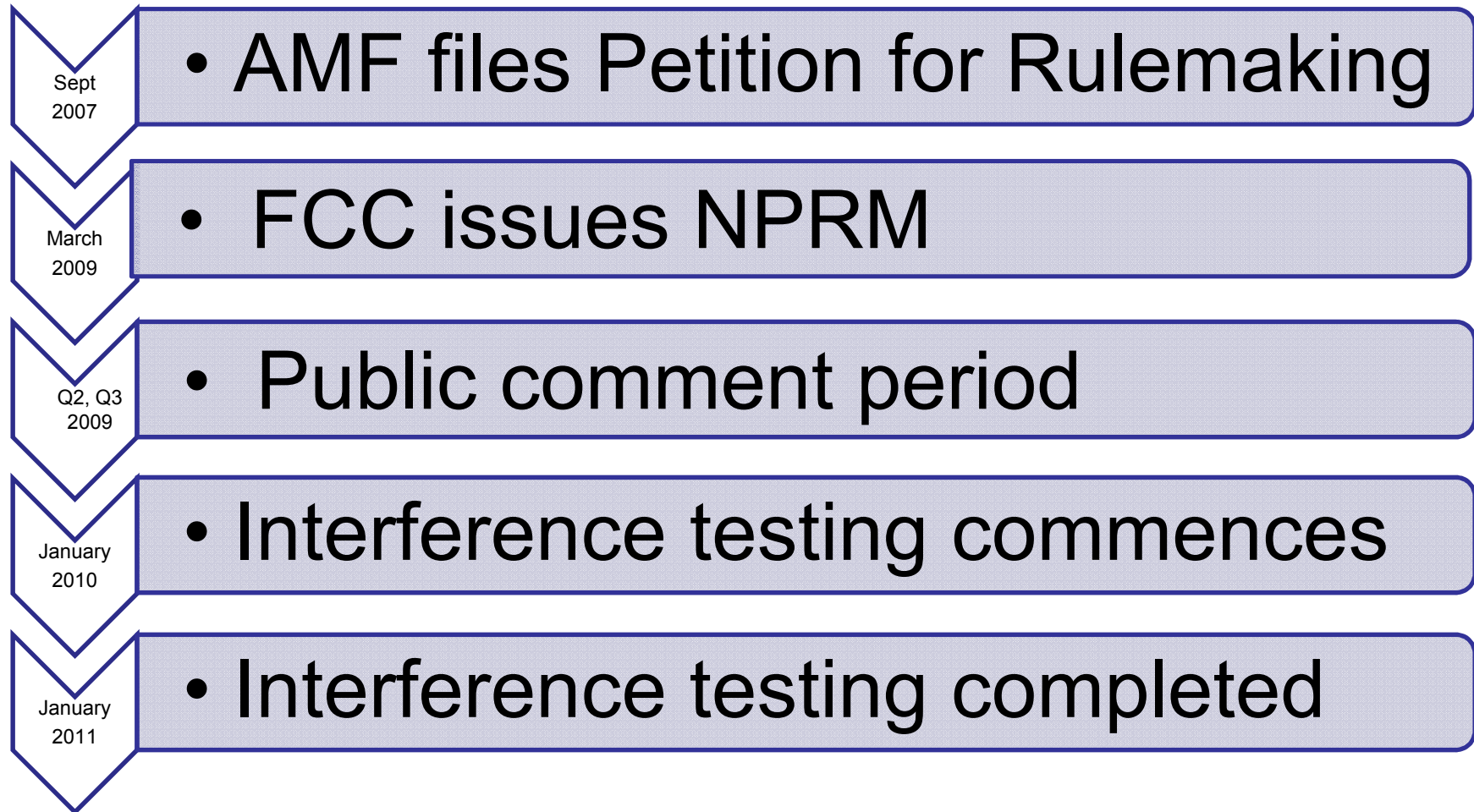
Radar

451 – 457  
MHz

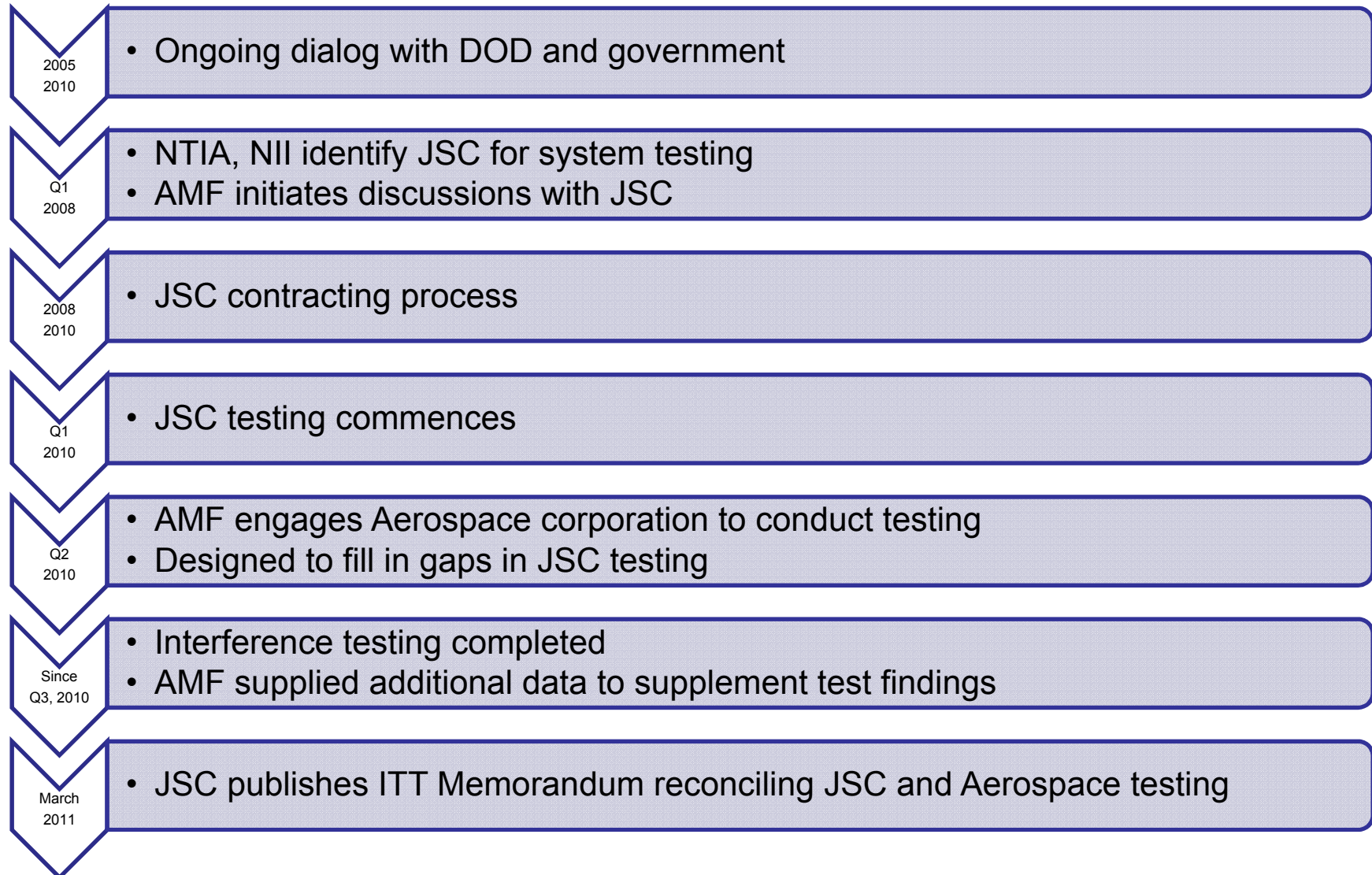
Commercial  
Channel/Land  
Mobile Radio

# Where We Have Been

# Chronology of Proceedings



# Interference Testing



# Testing Summary

- JSC Report
  - No harmful interference from MMN to incumbent systems
  - MMN system's interference mitigation measures may effectively eliminate harmful effects of interfering signals from LMRs and radar incumbents
  - Further testing to requested to confirm viability of mitigation measures
- Aerospace Report
  - Examined mitigation techniques
  - Concluded that MMN system can
    - Spectrally excise narrow band incumbent signals
    - Change channels without suspending critical functions
- Reconciliation Memo (JSC and ITT)
  - ITT, on behalf of JSC, concluded that Aerospace addressed the issues raised in JSC Report

# Where We Go From Here

# AMF Sponsored Clinical Applications

| Collaborator                  | Medical Condition                                       | Timing          |
|-------------------------------|---|-----------------|
| USC*                          | Dysphagia (head and neck cancer patients)               | March, 2011     |
| Veteran's Administration*     | TBI upper extremity rehabilitation                      | April, 2011     |
| Shriner's Children's Hospital | Spasticity relief for pediatric cerebral palsy patients | Q4, 2011        |
| Walter Reed/Bethesda Naval    | Prevention of Decubitus Ulcers                          | Planning phases |

\*Currently pending before FDA for approval



# Future Technical Development

## Implant

- Battery size/capacity
- Single chip architecture

## MCU

- Position, Temp Sensing
- Ecosystem interoperability

## Integration

- BMI, Exoskeletal
- Hospital

# Appendix 1

# JSC Report

- With respect to the government system-to-MMN interference potential, JSC Report concluded the following:
  - MMN “interference mitigation techniques of notching and dynamic channel switching ... *may effectively eliminate* the potential for [harmful interference] and allow the MMN to simultaneously operate with [incumbent government] systems at distances less than the calculated RSD.”
  - MMN systems may “operat[e] without interference [from incumbent government fixed radiolocation transmitters] at distances less than the predicted RSDs .... due to the anticipated low probability that the interfering and desired signals are received simultaneously, forward error correction techniques and the frequency agility of the MMN that is designed to dynamically switch channels when [harmful interference] is detected.”

## JSC Report

- JSC Report (prepared by Comsearch Government Solutions, as a subcontractor to ITT Corp., and reviewed and approved by JSC for publication) found **no significant MMN-to-government system interference potential**:
  - MMN systems “*should be operationally compatible and not cause unacceptable interference* into [incumbent government] systems currently authorized to operate in the 410-450 MHz band.”
  - The “*relatively small RSDs* [required separation distances] result from the low EIRP and duty cycle of the MMN transmitters combined with the low antenna heights of the MMN.”

## JSC Report

- JSC Report also examined various interference mitigation techniques (e.g., dynamic channel switching, notching, timing/duty cycle, and coding and forward error correction) incorporated into the MMN system design and other factors (e.g., protected fade margin, environmental factors, and microstimulator error response and default activity) expected to reduce significantly the calculated RSDs or the probability of harmful interference even within the calculated RSDs.
- JSC Report recommended the following:
  - testing to determine the effectiveness of interference mitigation methods to enable MMN systems to operate successfully in a high-powered government system environment; and
  - testing to validate the body loss used in the analysis and the equivalent isotropic radiated power of the implanted microstimulator when measured just outside the body.

# Aerospace Report

- In response to JSC Report recommendations, Aerospace Test Report (independently prepared by Aerospace at AMF's request, and reviewed and approved by Comsearch) performed tests demonstrating effectiveness of the following MMN interference mitigation techniques:
  - (1) MCU ability to spectrally excise narrowband incumbent signals;
  - (2) MMN ability to change channels without suspending critical functions;
  - (3) MMN ability to shut down gracefully in a communication link loss scenario; and
  - (4) MCU ability to sense the signal level of incumbent systems to avoid interference with incumbent systems.

# Aerospace Report

- Tests were performed using a wired test configuration designed to simulate RF environments and generate potential interfering RF signals from the following incumbent systems under worst-case operational parameters: (1) mobile radio (data traffic); (2) mobile radio (voice traffic); (3) ground radar; (4) airborne radar; (5) enhanced position location reporting system; and (6) amateur television.
  - Tested incumbent systems were representative of *both government and non-government systems* authorized for operation in the 413-457 MHz frequency band.
  - Tests were automated for repeatability and consisted of subjecting the AMF MMN system to interfering RF signals while monitoring the MCU's data link with the microstimulators.
  - Throughout testing, the power of the calibrated interfering signals was incrementally increased in level, thus requiring the MCU to mitigate the sensed interference.

## Aerospace Report

- Aerospace Test Report concluded that the test results verify that the AMF MMN system performs according to its specifications. Specifically, the report concluded that the MMN system is able to:
  - (1) spectrally excise narrowband incumbent signals;
  - (2) change channels without suspending critical functions;
  - (3) shut down gracefully in a communication link loss scenario;  
and
  - (4) sense the signal level of incumbent systems to avoid interference with incumbent systems by successfully changing channels.